**Introduction to Circuits**

**How Electrons Transfer Energy in a Circuit:**

* Each electron has electric potential energy
* Potential energy is the energy stored in an object
* Electrical circuits are responsible for powering electrical devices in our homes (ex. Stove, lights, computers, television etc.)

1. What causes the negative charges in a circuit to flow? (Hint: answer has to do with the battery).
   * They are attracted to the positive charges at the positive terminal
   * Each electron has to be a certain distance away from the electron right beside it
2. When you turn the light switch on a wall, you close the circuit and the light immediately comes on. How do the electrons get from the switch to the light bulbs so fast?

* Electrons do not travel from the switch to the bulb
* Electrons in the conductor “push” or repel other electrons nearby
* As soon as one electron starts to move at one end of the wire it pushes the next one, which pushes the next one and so on
* By pushing the first electron you make the last electron move
* That is why when you flip the switch, the light goes on instantly even though the electrons have not moved from the switch to the light bulb

**Series Circuits:**

**Series circuits have only one path along which electrons can flow and the components are arranged one after another or in a series.**

1. Draw a series circuit with two light bulbs, a 3 cell battery and a switch. Indicate the direction of the flow of electrons with an arrow.
2. What happens if one of the connecting wires breaks?

The electrons will not be able to pass through, and the circuit will stop working.

1. a) What happens if one of the light bulbs stops working? (Answer in terms of electron movement).

Electrons will not be able to pass through it.

1. Would the other light bulb still light up? Why or why not?

No, because there is no other path for the electrons to take.

**Parallel Circuit**

**In a parallel circuit the parts are arranged so that electrons can flow along more than one path. The points where a circuit divides into different paths or where paths combine are called junction points.**

1. Draw a parallel circuit with two light bulbs, a 3 cell battery and a switch. Indicate the direction of the flow of electrons with an arrow.
2. a) What would you expect to happen if one of the light bulbs stopped working? (Hint: think about the flow of electrons)

Electrons would not flow through that pathway/light bulb.

b) Would you expect the other light bulb to still work? Why or why not?

Yes it would still work, because electrons can take more than one path to light the other light bulb.

Notes:

* Each electron has electric potential energy
* Potential energy is the energy stored in an object
* What causes the negative charges in a circuit to flow?
  + They are attracted to the positive charges at the positive terminal
* The difference in electric potential energy between 2 points is called the potential difference or voltage (V)
* This difference causes current to flow in an electric circuit
* Higher the potential diference in a circuit, greater the potential energy of each electron

How Electrons Transfer Energy in a Circuit:

When you turn the light switch on a wall, you close the circuit and the light immediately comes on.

How do the electrons get from the switch to the light bulbs so fast?

* Electrons do not travel from the switch to the bulb
* Water in a hose (if theres already water in the hose, it comes out immediately)
* Electrons in a wire work in the same way
* When an energy source is connected to a circuit electrons in the conductor “push” or repel other electrons nearby
* As soon as one electron starts to move at one end of the wire it pushes the next one, which pushes the next one and so on
* By pushing the first electron you make the last electron move
* That is why when you flip the switch, the light goes on instantly even though the electrons have no moved from the switch to the light bulb

Current:

* Amount of electric charge that passes by a point in an electrical circuit
* As long as the battery continues to separate charges on its termainals electrons continue to flow
* Current flows in only one direction it’s called direct current (DC)
* Alternating current (AC) flows back and forth at regular intervals called cucles
* This is the current that comes from generators and is carried by the big power lines to your home
* Current is measured using an ammeter
* Unit of electric current is the ampere (A)
* Is a measure of the amount of charge moving past a point in the circuit every second
* Negative terminal – black, positive terminal – red

Resistance:

* Degree to which a substance opposes the flow of electric current through it
* Conductors such as metals allow electrons to flow freely through them and have low resistance values
* Insulators resist electron flow greatly and have high resistance values
* Resistance is measured in ohms and is measured using an ohmmeter
* When a substance resists the flow of electrons it slows down the current and converts the electrical energy into other forms of energy
* More resistance a substance has the more energy it gains from the electrons that pass through it
* Energy gained by the substance is radiated to its surroundings as heat and/or light energy
* Example: filament is a resistor (slows down the current and converts it to heat and light)
* In a resistor electrons have a higher potential difference when they enter a resistor compared to when they leave the resistor because they can use up some of the energy in passing through the resistor

Resistance in a Wire:

* Longer and thinner a pipe is the more resistance it has to the flow of water
* A pipe with a bigger diameter has less resistance which allows a greater flow of water
* For any given potential difference, current decreases if you add resistance
* As with water flow, you get the least resistance with a short, wide path with no obstructions
* The shorter and the thicker the wire, the less resistance it creates for electrons

Factor:

Material- Silver has the least resistance…but most use copper

Temperature- As the temp. increases, the resistance increases and conductivity decreases, a colder wire is less resistant than a warmer wire

Length- Longer wires offer more resistance than shorter wires (wire doubles in length, it doubles in resistance)

Cross-sectional area- wider wires offer less resistance than thinner wires, if wire doubles in width, resistance is half as great.

Chapter 11.2 – Series Circuits and Parallel Circuits

Series Circuit:

* Is an electric circuit in which the components are arranged one after another in series
* Important: A series circuit has only one path along which electrons can flow
* If the pathway is interrupted the whole circuit cannot function
* Amount of current is the same in all parts of a series circuit
* If you add more resistors you increase the total resistance of the circuit
* This will decrease the current
* Adding an extra bulb will make all of the bulbs dimmer
* Electrons use up all their potential difference no matter how many loads there are
* 12 V battery….will lose all 12 V before they return to the battery

Parallel Circuit:

* Parts are arranged so that electrons can flow along more than one path
* Points where a circuit divides into different paths or where paths combine are called junction points
* A break in one pathway does not affect the other pathways in the circuit
* Similarly adding a new pathway with more resistors does not affect the resistance in any of the other pathways
* Adding extra resistors in parallel decreases the total resistance of the circuit
* Most electrons will follow the path with the smallest resistance values
* Therefore the current is greater on the paths with the smaller resistance
* Each electron has the same amount of energy and electrons must expend all of their energy on the path they are on
* Therefore voltage is the same across all parallel resistors even if resistors have different values